

**MISSOURI DEPARTMENT OF NATURAL RESOURCES
AIR AND LAND PROTECTION DIVISION
ENVIRONMENTAL SERVICES PROGRAM
Standard Operating Procedures**

SOP #: MDNR-WQMS-012 EFFECTIVE DATE: March 14, 2005

SOP TITLE: Analysis of Turbidity Using the Hach 2100P Portable Turbidimeter

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SUMMARY OF REVISIONS: This is a new SOP.

APPLICABILITY: The procedures outlined in this SOP apply to all ESP personnel who analyze water samples for turbidity utilizing the 2100P portable turbidimeter.

DISTRIBUTION: MDNR Intranet

ESP, SOP Coordinator

RECERTIFICATION RECORD:

Date Reviewed				
Initials				

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure provides Environmental Services Program (ESP) staff with guidance on the following:

- The analysis of water samples for turbidity during field investigations
- Entry of turbidity data into LIMS
- Operation and maintenance of the 2100P Portable Turbidimeter

2.0 PERSONNEL QUALIFICATIONS

Field personnel must have a working knowledge of field sample collection procedures. Staff shall have, at a minimum, attended the department-sponsored Inspection and Enforcement training, Basic Sampling Workshop, or received training from another MDNR employee knowledgeable on proper sample collection procedures.

3.0 HEALTH AND SAFETY

Field activities involving the collection of turbidity measurements may involve working in or around various waste streams. Field personnel should protect themselves by wearing the appropriate level of personal protective equipment such as disposable gloves and waders.

4.0 GENERAL OVERVIEW

- 4.1 Turbidity is a unit of measurement quantifying the degree to which light travelling through a water column is scattered by suspended particles. Suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, plankton and other microscopic organisms cause turbidity in water.
- 4.2 The 2100P Portable Turbidimeter is considered a nephelometer as described in *Standard Methods For Water and Wastewater*. Nephelometers are the standard analytical instrument utilized for measurement of low turbidities in water. They employ a light source for illuminating the sample and a photoelectric detector to measure the intensity of light that is scattered.
- 4.3 The 2100P Turbidimeter provides a linear display of turbidity, throughout all ranges, in nephelometric turbidity units (NTUs).

5.0 SAMPLING CONSIDERATIONS

- 5.1 Turbidity can be determined for most water samples that are free of debris and coarse sediment, which settles rapidly.

- 5.2 When collecting turbidity samples, it is important that field personnel record observations such as weather conditions, time of day and any unusual stream/lake conditions (color, odor, suspended sediment, algae growth, etc.).
- 5.3 The sampler should be aware that results can be affected by dissolved air bubbles and dirty glassware.
- 5.4 Cuvettes must be kept scrupulously clean, both inside and out, and discarded if scratched. The procedure for cleaning cuvettes is described in Section 2.3.1 of the instrument manual.
- 5.5 If the turbidimeter has been subjected to cold temperatures (below 10°C/50°F) and then brought indoors, it should be allowed to warm before use to ensure no condensation is present on the lenses. Samples may also have to be warmed to prevent condensation from forming on the cuvette (see Section 2.3.7 of the instrument manual).

6.0 SAMPLE COLLECTION AND PRESERVATION

- 6.1 If turbidity is to be measured in the field the analysis should be performed on an aliquot of the sample as described in Section 10.0.
- 6.2 A grab sample containing a minimum of 100 mL and preferably 500 mL of sample should be collected in a clean plastic or glass container. Refer to MDNR-FSS-005 for the proper collection of grab samples and general sampling considerations. Each sample container must be labeled with a sample number and the date and time of collection. This information must be documented on the Chain-of-Custody Record (refer to MDNR-FSS-002 *Field Sheet and Chain-of-Custody Record* and MDNR-FSS-003 *Sample Numbering and Labeling*).
- 6.3 Turbidity should be determined as soon as possible after the sample is taken. Samples that can not be analyzed immediately should be refrigerated or cooled to 4°C in order to minimize microbiological decomposition of solids. All samples must be analyzed within 48 hours from the time of collection.
- 6.4 No preservatives should be added to the water sample.

7.0 SAMPLE HANDLING

- 7.1 Turbidity samples may be analyzed in the field or transported to the ESP laboratory for analysis.
- 7.2 If the analysis is to be performed in the lab, the turbidity samples should be logged onto a chain-of-custody (CoC) document, transported to the ESP lab and submitted to Sample Receiving as described in MDNR-FSS-018. The term

“Turbidity – WQMS” should be specified in the “Analyses” block of the CoC document. The sample can then be checked out by the sample collector and analyzed for turbidity as described in Section 10.0.

- 7.3 If the analysis is performed in the field, record the results on the CoC document as a field parameter in the box labeled “Other” and label as turbidity along with the units (NTU).

8.0 INSTRUMENT CALIBRATION

Complete calibration of the 2100P is not necessary during routine use. However, the unit should be recalibrated once every three months, or more often as experience dictates. This can be accomplished using the StablCal Stabilized Formazin or formazin standards. The procedure for complete calibration is detailed in the Instrument and Procedure Manual located in the instrument kit. A periodic check of the instrument’s calibration can be accomplished using the Gelex Secondary Standards (0-10 NTU, 0-100 NTU, and 0-1,000 NTU) that are stored with the meter. These secondary standards are designed for instrument verification only and should not be used for calibration. See section 3.6.4.2 in the instrument manual for more information on using the secondary standards.

Extreme care should be taken when handling the calibration standards, secondary standards, or sample cuvette. Surface scratches or finger smudges will cause analytical errors. Handle these items by the top only.

When using the 2100P, insert the cuvettes and rotate them until the factory-placed diamond mark on the cuvette aligns with the raised orientation mark on the front of the cell compartment.

9.0 INSTRUMENT CALIBRATION VERIFICATION PROCEDURES

- 9.1 The calibration of the 2100P should be verified each time that samples are analyzed.
- 9.2 Turn the instrument on by pressing the **I/O** button.
- 9.3 Select automatic range mode using the **Range** key.
- 9.4 Thoroughly clean the Gelex vials and apply a thin coating of silicone oil to the outside surface if needed.
- 9.5 Place the 0-10 Gelex stanard in the cell compartment so that the diamond on the cuvette aligns with the orientation mark on the instrument. Close the lid.
- 9.6 Press the **READ** button and record the displayed value in the logbook located in the instrument carrying case.

- 9.7 Repeat step 8.4 through 8.6 for the other Gelex standards, being careful to orient the cuvettes properly.
- 9.8 If the recorded readings are within 5% of the previously established values the unit is ready for use.

10.0 SAMPLE ANALYSIS

- 10.1 Before analyzing samples, the 2100P meter's calibration should be verified as described in Section 8.0.
- 10.2 The sample container should be gently inverted until the contents are thoroughly mixed. After mixing, allow sufficient time for air bubbles to escape, but do not let sample set long enough for turbidity-causing particles to settle.
- 10.3 Pour the sample contents into a clean, empty cuvette, filling it to within ½-inch of the top.
- 10.4 Place the cap on the cuvette and carefully clean the outside surface with a Kimwipe.

Note: Condensation may occur on the outside surface of the cuvette when a cold sample is being measured in a warm environment. This will interfere with turbidity measurement. Wipe moisture from the outside of the cuvette with a Kimwipe. Follow this by gently wiping the cuvette with the oiling cloth found in the carrying case. If fogging reoccurs, allow sample to warm slightly by letting it stand.

- 10.5 Gently invert the cuvette three to five times to ensure the sample is completely mixed. Care must be taken not to introduce air bubbles into the sample during mixing.
- 10.6 Place the cuvette in the optical well and align appropriately. Close the lid. Select automatic range selection by pressing the **RANGE** key. The display will show **AUTO RNG** when the instrument is in automatic range selection.
- 10.7 Press the **READ** key. The display will show ----NTU, then the turbidity in NTU. Record the turbidity reading after the lamp symbol on the display turns off.
- 10.8 Analytical results should be recorded on the turbidity bench sheet or CoC. See example of bench sheet attached.
- 10.9 If more than one sample is analyzed, the cuvette must be cleaned between samples. In most cases, this can be accomplished by triple rinsing the empty

cuvette container with distilled water and drying with a Kimwipe. When a more thorough cleaning is required, wash with mild lab soap, inside and out. Rinse cuvette with copious amounts of distilled water and air dry (or use Kimwipe to dry).

- 10.10 When analysis is complete, the sample(s) can be returned to sample receiving or discarded appropriately. This should be noted on the bench sheet.

11.0 DATA ENTRY IN SAMPLE MASTER

- 11.1 If the sample is analyzed in the laboratory by field staff the sample analyst is responsible for entry of turbidity results into the Laboratory Information Management System (LIMS). This task is accomplished using the software program Sample Master (version 7.0.06).
- 11.2 Open Sample Master and access the main menu.
- 11.3 Press the SECOND TAB labeled "Data Entry".
- 11.4 Highlight "Result Entry" and press the SELECT button.
- 11.5 Specify the test as "Turbidity-WQMS". Then, specify the order number of the sample. (Note: the order number can be obtained from Sample Receiving when samples are submitted). Other information may also be specified such as site and date of collection. Press the RETRIEVE button.
- 11.6 On the top, left corner of the window will be a set of four buttons. Select the RESULTS TO ENTER button.
- 11.7 On the bottom half of the window, select the tab labeled SAMPLE RESULTS.
- 11.8 In the table, find the line that corresponds to the subject sample; then enter turbidity data in the column labeled "Result". Check the checkbox in the column labeled "+". (Place a checkmark only when a sample result is entered. If turbidity data for a particular line is not entered, leave the checkbox blank).
- 11.9 Once all results have been entered and the values checked for accuracy, checks should be placed in the appropriate checkboxes. Press the ENTER button at the bottom right corner of the window.
- 11.10 You may repeat this procedure to enter other sample data or close the Sample Master program.

12.0 REFERENCES

MDNR-FSS-001 *Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations.*

MDNR-FSS-002 *Field Sheet and Chain-of-Custody Record*

MDNR-FSS-003 *Sample Numbering and Labeling*

MDNR-FSS-005 *General Sampling Considerations Including the Collection of Grab, Composite, and Modified Composite Samples from Streams and Wastewater Flows.*

MDNR-FSS-018 *Sample Handling: Field Handling, Transportation, and Delivery to the ESP Lab.*

Standard Methods for the Examination of Water and Wastewater, 1995, 19th Edition.

Model 2100P Portable Turbidimeter Instrument and Procedure Manual, Hach Company, 1991-1999, 2001

TURBIDITY
(Model 2100P Turbidimeter)

Analyst _____

Date _____

[illegible]

**2100P Portable Turbidimeter
and Secondary Standards (0-10, 0-100 and 0-1,000 NTU)**

